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Best Practice

Haematological Cancers: Improving Outcomes. A Summary of Updated NICE Service Guidance in relation to Specialist Integrated Haematological Malignancy Diagnostic Services (SIHMDS)

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Abstract

Haematological malignancies are a diverse group of cancers that affect the blood, bone marrow and lymphatic systems. Laboratory diagnosis of haematological malignancies is dependent on combining several technologies, including morphology, immunophenotyping, cytogenetics and molecular genetics correlated clinical details and classification according to the current WHO guidelines. The concept of the Specialised Integrated Haematological Malignancy Diagnostic Services (SIHMDS) has evolved since UK NICE Improving Outcomes Guidance (IOG) in 2003 and subsequently various models of delivery have been established. As part of the 2016 update to the NICE IOG, these models were systematically evaluated and recommendations produced to form the basis for quality standards for future development of SIHMDS. We provide a summary of the systematic review and recommendations. Although the recommendations pertain to the UK NHS, they have relevance to the modern delivery of diagnostic services internationally.

Definitions

Local reporting: service models in which haematological cancer diagnosis is made within a local laboratory of an associated clinical department.

Co-located: service models in which haematological cancer diagnosis is provided in dedicated, purpose-built and localised laboratories.

Networked: service models in which established laboratories work on the same information network, but are geographically separate and not dedicated solely to haematological cancer diagnosis.

Integrated report: A single report summarising all elements of laboratory diagnosis for a specific patient episode i.e. based on available haematological cytology, histopathology, immunophenotyping by flow cytometry, cytogenetics, FISH and molecular genetics and in accordance with the current WHO diagnostic classification.

Integration: The process of producing an integrated report.

Introduction

National Institute for Health and Care Excellence (NICE) service guidance is based on the best available evidence of clinical and cost effectiveness, and is produced to help commissioners, NHS Trusts, managers, healthcare professionals and patients make informed choices about appropriate healthcare to improve the effectiveness and efficiency of healthcare services.

Haematological malignancies include leukaemias, lymphomas and myeloma and originate mainly in the bone marrow and lymph nodes. They are a diverse group of diseases affecting people of all ages, but with highest incidence among the elderly. Prognosis and responsiveness to treatment of these conditions also varies widely. Haematological malignancies accounted for 8.4% of all malignant disease (excluding non-melanoma skin cancer) diagnosed in England in the years 2001 to 2010[1]

Accurate diagnosis of haematological malignancies involves haematological and histopathological cytomorphology, immunophenotyping by flow cytometry and/or immunohistochemistry, cytogenetics and molecular genetics, including cutting edge technologies, such as next generation sequencing (NGS). Clinical information is also essential, both at the time of specimen analysis and when discussing diagnostic reports in a multidisciplinary team meeting. This approach is built into the World Health Organisation (WHO) classification for all haematological malignancies and updates of this classification[2-4] provide a diagnostic framework that emphasises the importance of integrating all these modern diagnostic tests.

Historical evidence, based principally on lymphoma, supports between 5% and 15% of haematological malignancies being misdiagnosed, sometimes with major clinical consequences[5-7]. Such errors can be difficult to detect after a patient has been treated and so it is very important that the initial diagnosis is correct and supported by strong evidence from several independent investigative modalities.

In the United Kingdom (UK) the 2003 NICE Improving Outcomes Guidance (IOG) for Haematological Malignancies emphasised the importance of an integrated diagnostic

approach to haematological malignancies[8]. The original guidance defined two levels of haematological malignancy diagnostic service - a local service, which provides initial assessment of specimens and a specialist laboratory service. A specialist service uses predefined diagnostic pathways to analyse specimens using a variety of diagnostic modalities, then validates and correlates the results to produce an integrated diagnostic report. This approach has been gradually adopted across the country and the specialist laboratories are now known as Specialist Integrated Haematological Malignancy Diagnostic Services (SIHMDS).

Despite the 2003 NICE IOG for Haematological Malignancy recommendations that all diagnostic technologies should be provided by a single laboratory ('co-located' services), the adoption of a single co-located SIHMDS structure has been variable across England with little progress beyond local reporting by separate laboratories in some regions.

In 2016 the IOG was revised and included an economic appraisal of SIHMDS as well as additional guidance relating to these laboratories[1]. The original IOG was limited to adult patients (age 16 years or more) despite a similar requirement for integrated diagnostic technologies in the diagnosis of haematological cancers in childhood in accordance with the WHO classification. The updated NICE IOG applies to all ages.

The aim of this best practice review is to summarise the evidence and recommendations for SIHMDS laboratories included in the revised IOG for Haematological Malignancies. Although the NICE guidance will be most relevant to SIHMDS in England, the general principles will be relevant to specialised laboratory practitioners and healthcare providers who work in the field of cancer internationally.

Methods: Evidence review during NICE Improving Outcomes Guidance development in relation to SIHMDS

a) Service configuration

Most of the published research on cancer topics focuses on clinical evaluations of treatment; little direct research has been carried out on the organisation and delivery of services.

b) Epidemiology

This was key to the review in order to understand the routes through which patients with haematological malignancies might present initially or at relapse to healthcare services, to inform the shape of these services.

Accurate capture of information on haematological malignancies nationally, despite recent improvements, is still challenging. Haematological malignancies are diverse, ranging from highly aggressive types to incidentally identified indolent conditions. Certain chronic leukaemias rarely produce symptoms, and the recorded incidence of these conditions depends on whether blood samples are examined and on the criteria used for deciding whether there is a malignancy. Even when it is clear that there is a malignancy, identifying the specific type requires sophisticated diagnostic techniques and the integration of information from clinical and laboratory sources. These results are not always available to the Cancer Registries and so some registrations fail to capture the precise diagnosis. This is particularly true of non-Hodgkin lymphoma (NHL), a large and varied group of conditions, for which the ICD-10 coding may be inadequately detailed to separate distinct entities or present other challenges for accurate classification in routine practice.

Data sources for the guideline included the National Cancer Registration Service (NCRS), which is part of Public Health England (PHE), the National Cancer Intelligence Network (NCIN), the Office for National Statistics (ONS), the Patient Experience Survey, National Audit of Cancer Diagnosis in Primary Care, Hospital Episode Statistics (HES), National Cancer Data Repository (NCDR) and regional data taken from the Haematological Malignancies Research Network (HMRN).

Population-based national incidence rates for England (as estimated by cancer registrations) rose over the period 2001-2010 for some haematological cancers: Hodgkin lymphoma, non-Hodgkin lymphoma (NHL) and myeloma. There are no haematological cancers for which incidence rates declined over that period. Registration rates for haematological cancers may have changed because of better ascertainment of new cases and developments in both diagnosis and classification; therefore the changes seen may not represent true changes in incidence[1].

Relative survival improved for individuals in specific age groups who were diagnosed between 2000 and 2010 for a number of haematological cancers: acute lymphoblastic leukaemia (0-14 years males and females; 15-64 years males), acute myeloid leukaemia (15-64 years), chronic myeloid leukaemia, non-Hodgkin lymphoma, and myeloma. For the most common forms of leukaemia in older people (adults aged 65 years or more), namely acute myeloid leukaemia and chronic lymphocytic leukaemia, there was no evidence of significant change in the outcome for patients over this time period[1].

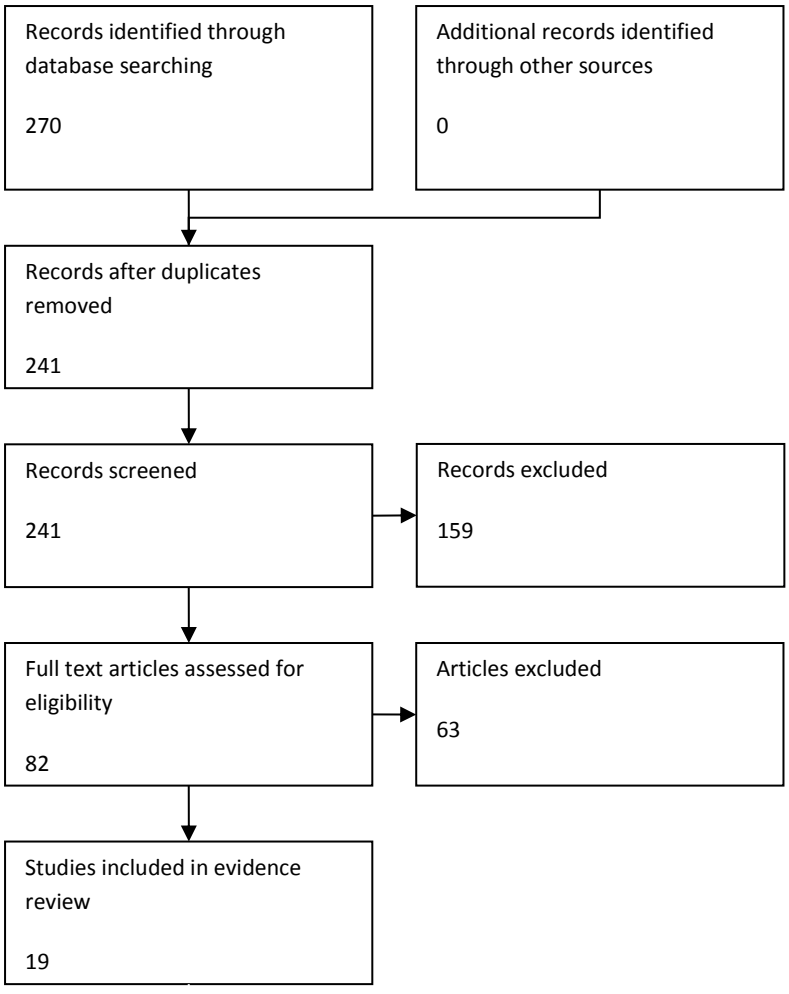
The incidence of haematological malignancy does not generally vary between areas with different levels of deprivation, apart from acute myeloid leukaemia (AML) and Hodgkin lymphoma. Deprivation was also associated with poorer relative survival for chronic lymphocytic leukaemia (CLL), chronic myeloid leukaemia (CML), Hodgkin lymphoma, myeloma and NHL[1].

For the majority of haematological malignancies, GP referral was the most common route to diagnosis, with the exception of AML and ALL, in which over half of all patients presented to hospital as an emergency. CML and myeloma had similar proportions of GP referral and emergency presentations. All haematological malignancies with the exception of Hodgkin lymphoma had a significantly higher proportion of emergency presentations than malignancies in general. Relative survival was significantly poorer for emergency presentations for most haematological malignancies. The exception to this was ALL, where one-year relative survival for emergency presentations was similar to that from all other routes. For some acute haematological malignancies emergency presentation may be the most appropriate route to diagnosis[1].

c) Evidence review and quality grading

Searches were carried out in Medline. Premedline, Embase, Cochrane, LibraryWeb of Science (SCI & SSCI) and ISI Proceedings, HMIC, PscyInfo, CINAHL, Joanna Briggs Institute EBP database, OpenGrey, HMRN (Haematological Malignancy Research Network) and British Committee for Standards in Haematology from January 2000 until April 2015. Results of the searches are detailed in Figure 1. In total 19 studies were included in the review (table 1)[5-7, 9-24].

Figure 1: Search Results



The evidence was considered to be of low quality overall as all the identified studies were retrospective case series and none of them directly compared integrated diagnostic services with other forms of diagnostic service. There was a high risk of bias based on the potential lack of blinding and the possibility of selection bias.

One study (Engel-Nitz et al, 2014) however compared diagnostic outcomes between specialist haematology laboratories and other commercial laboratories, reporting that patients in the specialist laboratory cohort were more likely to undergo more complex diagnostic testing with 26% of patients undergoing molecular diagnostics compared with 9.3% in community based hospital laboratories. Patients in the specialist laboratory cohort were 23% more likely to reach a final diagnosis within a 30 day testing period when compared with community based hospital laboratories.

Table 1: Studies included in Evidence Review

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
1	**Bowen et al (2014)**	Retrospective Study	To determine the rate of revised diagnosis and subsequent impact on therapy following a second review	N=1010	Second Review Diagnosis	Primary referral diagnosis	Diagnostic Discrepancies
2	**Chang et al (2014)**	Retrospective Study	To review the final diagnoses made by general pathologists and analyse the discrepancies between referral and review diagnosis	N=395	Expert Review	Initial Diagnosis	Diagnostic Discrepancies
3	**Engel Nitz et al (2014)**	Retrospective Study Laboratory	To compare diagnostic changes, patterns of additional testing, treatment decisions and health care costs for patients with suspected haematological malignancies/conditions whose diagnostic tests were managed by specialty haematology laboratories and other commercial laboratories.	N=24,664 patients Genoptix N=1,387 Large Labs N=4,162 Other Controls (community hospital labs) N=19,115	Initial interim diagnosis	Final Diagnosis	Diagnostic Uncertainty Stability of Diagnosis
4	**Gundlapalli et al (2009)**	Survey	To address the hypotheses that clinical providers perceive composite laboratory reports to be important for the care of complex patients and that such reports can be generated using laboratory informatics methods	N=10 clinical staff	Survery and interview	None	End user survey opinions

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
5	**Herrera et al (2014)**	Retrospective Study	To evaluate the rate of diagnostic concordance between referring centre diagnoses and expert haematology review for 4 subtypes of T-cell lymphoma	N=89	Review of primary diagnosis at an NCCN centrte	Primary diagnosis at a referring centre	Concordance
6	**Irving et al (2009)**	Report	To show that the standardised protocol has high sensitivity and technical applicability, has good concordance with the gold standard molecular based analysis and is highly reproducible between laboratories across different instrument platforms.	No details	Standardised protocol for flow cytometry	Gold standard molecular technique	Internal and external quality assurance testing of flow minimal residue disease Sensitivity and varibility of the standardised method Applicability of the standardised method in prospective samples Comparison of minimal residual disease as measured by PCR and by flow cytometry
7	**LaCasce et al (2005)**	Retrospective Study	To determine the rate of discordance for 5 common B-cell NHL diagnoses in five tertiary centres participating in a large national lymphoma database The determine whether additional information was obtained at the National Comprehensive Cancer Network (NCCN) centre To estimate the likely impact of a change in diagnosis on treatment	N=928	Pathologic diagnosis from the referral centre was compared with the final WHO diagnosis at the NCCN centres Etiology of the discordance was investigated along with the potential impact on treatment.	No Details	Pathologic Discordance

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
					A random sample of concordant cases (10%) were also reviewed		

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
8	**Lester et al (2003)**	Retospective Study	To establish the impact of the All Wales Lymphoma Panel review on clinical management decisions	N=99	Cases submitted for central review	Actual management plan received by the patient	Change in management
9	**Matasar et al (2012)**	Retrospective Study Laboratory Setting	To test the hypothesis that increased familiarity with the WHO classification of haematological malignancies is associated with a change in frequency of major diagnostic revision at pathology review.	N=719	Diagnosis and review in 2001 using the WHO classification of haematological malignancies	Diagnosis and review in 2006 using the WHO classification of haematological malignancies	Agreement between the submitted and review diagnosis (most recent diagnosis was considered the submitted diagnosis) Factors associated with the rate of major diagnostic revisions
10	**Norbert-Dworzak et al (2008)**	Prospective Review	To investigate whether flow cytometric assessment of minimal residual disease can be reliably standardised for multi-centric application	N=413 patients with acute lymphoblastic leukaemia (Centre 1=110, Centre 2=88, Centre 3=61, Centre 4=154) N=395 patients with blood and bone marrow samples received at diagnosis and from follow-up during induction treatment: PB at day 8, 15, 22, and 33; BM at day 15, 33 and 78).	Flow Cytometry according to a standard protocol	Results from each centre following standard protocol	Qualitative Concordance of Analyses of Exchanged List-Mode Data Quantitative Concordance of Analyses of Exchanged List-Mode Data Concordance of Risk Estimates upon Analyses of Exchanged List-Mode Data Reproducibility in Inter-Laboratory Sample Exchange Agreement of MRD Results from independent patient cohorts
11	**Norgaard et al (2005)**	Retrospective Study	To examine the data quality and quantifying the impact of any misclassification of the	N=1159	Danish Cancer Registry (DCR)	North Jutland Hospital Discharge	Degree of completeness Positive Predictive Value Survival

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
			diagnoses on the survival estimates			Registry	
12	**Proctor et al (2011)**	Retrospective Study	A large scale assessment of expert central review in a UK regional cancer network and the impact of discordant diagnoses on patient management as well as the financial and educational implications of providing a centralised service.	N=1949	Expert Review	Initial Diagnosis	Concordance
13	**Rane et al (2014)**	Retrospective Study	To evaluate the ability and interobserver variability of pathologists with varying levels of experience and with an interest in lymphomas to diagnose Burkitt Lymphoma in a resource limited set up.	N=25	Consensus Diagnosis	Initial Independent Assessment	Initial Independent Assessment Interobserver variation in morphological features Parameters used to differentiate between classic CL, atypical BL and B-cell lymphoma intermediate between DLBL and Burkitt lymphoma. Consensus Diagnosis Concordance with consensus diagnosis Effect of tissue fixation, age group and provision of additional information on revision of diagnoses Accuracy of pathologist's Sensitivity and Specificity to diagnose Burkitt Lymphoma

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
14	**Siebert et al (2001)**	Retropsective Study	To compare diagnoses made at a community and an academic centre to evaluate the reproducibility of the revised European-American Classification	N=188	Review of community hospital assessments at an academic centre	lymphoid neoplasms subtyped according to revised European-American classification criteria at a community hospital	Concordance
15	**Stevens et al (2012)**	Retrospective Study	To observe concordance and discrepancies between local findings and the specialist opinion.	N=125	Central Review	Regional/Community Hospital Review	Pathology Staging Therapy
16	**Strobbe et al (2014)**	Retrospective Study	To investigate whether implementation of an expert panel led to better quality of initial diagnoses by comparing the rate of discordant diagnoses after the panel was established compared with discordance rate 5 years later To evaluate whether lymphoma types with high discordance rate could be identified	N=161 referred to the expert panel N=183 reviewed at a later date	Expert Panel review	Initial Diagnosis	Discordance rate in 2000-2001 Discordance rate in 2005-2006
17	**Van Blerk et al (2003)**	Retrospective Study	To report first experiences from Belgian national external quality assessment scheme (EQAS)	N=17	External quality assessment review	N/A	Stability Intralaboratory reproducibility Homogeneity Interlaboratory reproducibility Single vs. Dual Platform

Study		Study Type/Setting	Aim	Population	Intervention	Comparison	Outcomes
							Influence of Gating strategy CD4+,CD3+ and CD8+CD3+ cells versus total CD4 and CD8 cells Abnormal Samples
18	**Van de Schans et al (2013)**	Retrospective Study	To evaluate the value of an expert pathology panel and report discordance rates between the diagnosis of initial pathologists and the expert panel and the effect on survival	N=344	Expert review of diagnosis	Initial Diagnosis	Discordance Rate
19	**Zhang et al (2007)**	Retrospective Study	To compare similarities and differences in results from participating laboratories and to identify variables which could potentially affect test results to discern variables important in test standardisation	N=38 laboratories	Quantitative testing for BCR-ABL1	Results from different participating laboratories	Test accuracy at different dilutions

d) Cost Effectiveness Analysis

No previous studies of cost effectiveness were identified as part of the evidence review. An economic model was therefore developed to inform the guideline. The economic model considered the cost effectiveness of two overall models of haematological malignancy diagnostic service delivery: (a) local reporting of diagnostic results with a proportion of tests being referred to SIHMDS for review and (b) referring all samples immediately to SIHMDS for suspected haematological malignancies. When considering the SIHMDS itself, two comparative configurations of SIHMDS were considered: (a) networked and (b) co-located. Health outcomes were calculated as lifetime Quality Adjusted Life Years (QALYs) and all costs to the NHS and Personal Social Services (PSS) were considered. Costs were predominantly taken from accounting data of one networked and one co-located SIHMDS. Health outcomes were based on the Guideline Committee's assumptions on the impact of misdiagnoses informed by clinical evidence of treatment for haematological malignancies. In the absence of strong evidence differentiating the two SIHMDS approaches their health outcomes were assumed identical. A range of sensitivity analyses were performed to test differing assumptions and to assess the robustness of and uncertainty around outcomes.

In the model, both approaches of SIHMDS had a lower cost per diagnosis and higher QALYs per patient compared to local reporting with subsequent referral of a proportion of cases to the SIHMDS. When comparing SIHMDS structure, a co-located approach was estimated to be £19 cheaper per diagnosis compared with a networked approach, although this was not robust during sensitivity analysis.

Change in staffing, capital and set-up costs were not considered as part of the economic modelling with this varying widely across England. It was acknowledged that there may be a significant initial resource impact on some centres around obtaining laboratory accommodation, implementation of integrated IT systems and the appointment of dedicated SIHMDS staff.

There was no evidence to directly compare outcomes from co-located and networked haematology diagnostic services and strong conclusions regarding the

preferred configuration of SIHMDS could not be drawn solely from the results of the economic model. One study[11] reported significantly better clinical outcomes for a specialist haematology diagnostic laboratory, but it was unclear from the information provided, whether this study directly compared co-located and networked services. Communication with the author of the study added extra information about the comparisons made and the Guideline Committee debated whether this warranted a recommendation for a co-located diagnostic service to optimise integration of the increasingly complex range of tests involved in the diagnosis of haematological malignancies required to fulfil WHO specifications. There was consensus in the Guideline Committee that a co-located service was the optimal approach and that, because it allowed more effective processes and procedures to be put in place, better communication between laboratory personnel and better quality control, it should be recommended, despite the lack of strong evidence.

The Guideline Committee agreed that there were a number of geographical and infrastructural barriers to establishing a co-located service and that the priority in any diagnostic service was delivering a high quality service that produced timely integrated reports. Although this was likely to be best met through a service with all the component parts located on a single site, this would not always be feasible and so a networked service might be a more appropriate option for certain parts of England. To clarify the key service requirements, the Guideline Committee developed a set of consensus-based recommendations outlining the key organisational, structural and managerial parameters, which should be fulfilled by any SIHMDS, whether co-located or networked. No specific evidence was identified about paediatric diagnosis but the Guideline Committee considered that diagnosis of paediatric patients would follow the same diagnostic pathways as that of adult patients and so the recommendations should cover all age groups.

Recommendations

The following is a list of the new, updated recommendations for 2016. For all recommendations, the quality of the evidence was considered to be low.

The Guideline Committee considered that recommendations are most likely to be achieved if the component parts of the SIHMDS are located at a single site.

All SIHMDS should:

- have clearly defined organisational structures
- have a formally appointed SIHMDS director who is responsible for the operation of the service, including the design of the diagnostic pathway, resource use and reporting standards
- have a single quality management system
- be formally accredited as a SIHMDS by a recognised independent organisation
- be managed by a single trust/organisation
- assess the clinical benefit and the financial and resource impact of new diagnostic and therapeutic technologies before introducing them
- have a central reception point for all specimens
- have a full range of age-appropriate specialist haematology and haematopathology input for diagnosis and the authorisation of integrated reports
- have a full range of protocols covering specimen handling, diagnostic pathways and compilation of integrated reports
- ensure that their location, organisation, infrastructure and culture allow effective day to day and *ad-hoc* communication for rapid resolution of diagnostic uncertainty and accurate diagnosis
- have clear and reliable systems for communicating with relevant healthcare professionals outside the SIHMDS
- produce integrated reports that include all information needed for disease management, and share these with the relevant multi-disciplinary team.
- report diagnoses sub-typed by the current WHO classification.

All SIHMDS should have a predefined diagnostic pathway that is followed for each specimen type or clinical problem. The pathway should ensure that:

- the most appropriate diagnostic platforms are selected for a particular clinical situation to avoid unnecessary duplication
- tests for each specimen are used to provide maximum levels of internal cross-validation, using the current WHO principle of multi-parameter disease definitions

- there is a robust process for report validation, including double reporting.

All SIHMDS should have an IT system that allows:

- specimen booking and registration at source
- input and update of clinical information
- integrated reporting
- two-way communication between SIHMDS and healthcare professionals using the SIHMDS.

The SIHMDS director should be responsible for the overall quality management system, including:

- laboratory processes and the quality of diagnostic reporting
- ongoing assessment of staff competencies
- training provision
- communication within the SIHMDS and with relevant healthcare professionals
- audit and quality assurance
- research and development.

If an urgent treatment decision is not needed, local diagnostic laboratories should send all specimens (including lymph node and other tissue material) directly to a SIHMDS without any local diagnostic workup:

- as soon as a haematological malignancy is suspected
- during active investigation of a suspected haematological malignancy
- if patients with an established or previous malignancy have suspected relapse or disease progression.

If an urgent treatment decision is needed and local diagnostic workup will not reduce the speed or quality of the SIHMDS assessment and integrated reporting, local diagnostic laboratories should process and report on blood film, bone marrow aspirate and cerebrospinal fluid cytology specimens.

SIHMDS should release individual laboratory reports before the integrated report is produced, if there is an urgent clinical need.

SIHMDS should be responsible for specimens that are sent to external labs and should integrate the results into the relevant report (unless there are exceptional arrangements in place for clinical trials).

Disease monitoring

When flow cytometry, molecular diagnostics or cytogenetics are needed for disease monitoring, local diagnostic laboratories should send all relevant specimens directly to a SIHMDS without any local diagnostic workup.

Discussion

The concept of SIHMDS is not new and was a result of recognition that haematological malignancy diagnosis is increasingly complex and dependent on new sophisticated laboratory technology. Separate laboratory reporting and reliance on clinicians to interpret and synthesise each result and stay up-to-date with ongoing revisions in classification is likely to compromise diagnostic quality despite the dual clinical and laboratory training and certification achieved by the majority of haematologists in the UK. This is due to the complexity of current diagnostic methods and the requirement to internally validate and cross-check information, at source, in order to preventing reporting of erroneous results.

From the late 1990s, some UK centres adopted an integrated approach which was incorporated into the NICE IOG in 2003 and subsequent cancer peer review standards. Despite this, many services did not progress integrated reporting beyond an elementary stage, consistent with local reporting. Additionally, although modern diagnostic technology and classifications are relevant to all age groups, patients under 16 had a different standard of care to those over 16. Others developed different models; some using co-located facilities and others using networked but geographically distinct laboratory facilities to produce integrated reports. As there were pros and cons associated with both models, the Guideline Committee considered an economic analysis as well as clinically important aspects in formulating their recommendations.

A fully co-located service is a logical and convenient means of delivering SIHMDS. It permits consolidation of expert diagnostic staff and expensive technologies and is more likely to result in reduced turn-around times, improved diagnostic accuracy, reduced need for repeat sampling and greater cost efficiency. This should in turn lead to more effective treatment and less anxiety for patients. However, there are a number of potential barriers to setting up co-located SIHMDS services, in particular the need to restructure services. Some laboratories such as histopathology and molecular genetics have a broad remit across all cancer and non-cancer specialities, which prevents separation of their haematological services into a co-located SIHMDS. In rural regions, geographically isolated and disparate units with relatively

small populations may find this restructuring a challenge with particular regard to recruitment, job satisfaction and ability to effectively communicate and attend MDT meetings: although modern telecommunications and developing digitalization could mitigate some aspects.

Balancing potential benefits against challenges around service reconfiguration, staff satisfaction, haematology training provision and recruitment, there was agreement that these recommendations were in the best interests of the service and the patients.

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